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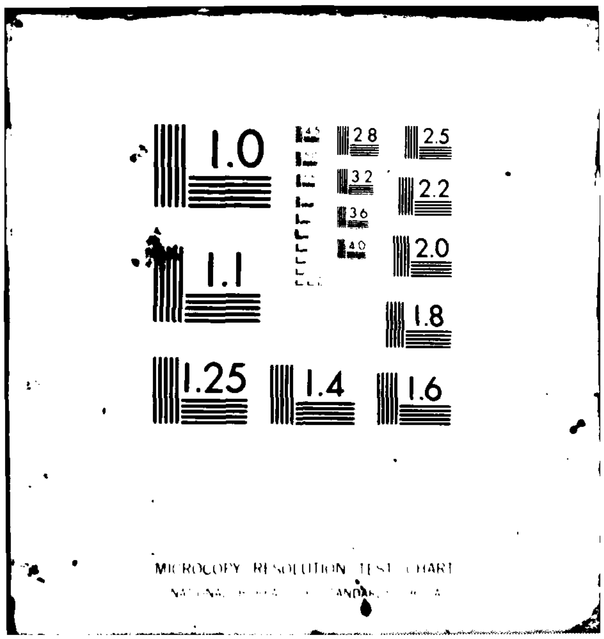
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MATHEMATICS SKILL LEVELS IN NAVY CLASS "A" ELECTRONICS SCHOOLS

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Based on results of a survey that identified the mathematics skills needed to perform successfully in Navy electronics "A" schools, mathematics tests were developed to assess the mathematics skills of entering and graduating electronics "A" school students. The tests were administered to about 1000 entering and 1200 graduating students at "A" schools for nine electronics ratings. Analysis of test scores obtained showed revealed significant differences between entering and graduating students on these mathematics topics taught as part of the electronics course training. However, no significant

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differences were found between the two groups on topics that were prerequisites to the training.

FOREWORD

This research and development was conducted under exploratory development task area ZF63.522.011 (Assessment and Enhancement of Prerequisite Skills), work unit 522.011.03.02 (Enhancement of Computational Capabilities), and was sponsored by the Chief of Naval Education and Training (OP-01). The objectives of this work unit are to identify mathematics skill deficiencies among Navy electronics personnel, to determine the causes of such deficiencies, and to develop instruction strategies to improve the efficiency and job relevance of Navy electronics training.

This is the second of a series of reports designed to identify mathematical requirements relevant to electronics training. The first (NPRDC TR 81-4) identified mathematical skills required for successful performance in the Navy electronics "A" schools. This report compares the mathematics skills of entering and graduating "A" school students and investigates the relationship between mathematics scores and course performance. Results are intended for use by the Chief of Naval Education and Training and the Chief of Naval Technical Training.

Appreciation is expressed to the "A" school instructors and students who participated in this study.

The contracting officer's technical representative was Dr. Meryl S. Baker.

JAMES F. KELLY, JR.
Commanding Officer

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A

SUMMARY

Problem

To provide skilled maintenance technicians for increasingly sophisticated electronic equipment, specific mathematics skills must be related to student performance in Class "A" school electronic courses. Further, student ability to perform mathematics skills designated as critical to successful course performance must be assessed so that deficiencies can be identified and corrected. To address this problem, the Center is conducting research and development designed to identify mathematical requirements relevant to electronics training. A previous report issued concerning this work described the mathematics skills identified as needed to perform successfully in Navy electronics "A" schools.

Objective

The objectives of this effort were to compare the mathematics capabilities of entering and graduating electronics "A" school students and to determine how mathematics scores relate to course performance data.

Approach

Based on the results of the previous report, mathematics tests were developed to assess the mathematics skills of entering and graduating electronics "A" school students. The test items were "custom" assembled into individual tests of approximately 100 items for each of the 10 schools to assess the particular skills involved. The tests were administered to approximately 1000 entering and 1200 graduating students at nine schools. Armed Services Vocational Aptitude Battery (ASVAB) scores were obtained for all the students and "A" school performance data were obtained for the graduating students.

Mathematics test scores and ASVAB scores were analyzed to identify the differences between entering and graduating students. Also, correlations were computed for mathematics test scores and school performance data for the graduating students.

Findings

1. The mathematics test scores of entering and graduating students differed significantly on topics taught as part of the electronics course training. This pattern was particularly noticeable for advanced topics such as Boolean Algebra and Number Bases.

2. No significant differences were found between entering and graduating students on mathematics topics rated as prerequisites, including Arithmetic Operations, Fractions, Estimation, and Equations.

3. In all the "A" schools surveyed, student mathematics test scores correlated significantly with at least one course performance measure.

4. There were significant correlations between course-performance measures and some ASVAB variables, especially mechanical comprehension, electrical knowledge, mathematics knowledge, general information, and space perception subtests.

5. Eliminating mathematics-related items from course examination, where item information was available, generally resulted in reduced correlations between total

mathematics test and topic scores. There was sufficient correlation in most cases, however, to warrant the conclusion that the mathematics test scores are related in some degree to the nonmathematics aspects for "A" school performance measures.

6. Across all schools, mean percent correct ranged from 0 to 72 on mathematics items rated by course instructors as being critical for successful course performance.

7. Where more advanced mathematics skills such as those involved in Number Bases and Boolean Algebra were taught at the "A" school, the instruction produced significant differences between mean scores on these topics for entering and graduating students.

Conclusions

1. A background in basic mathematics obtained prior to "A" school training is generally adequate for courses involving basic electronics concepts, but advanced mathematics is necessary for success in those courses involving sophisticated electronics concepts.

2. Performance in mathematics in the electronics ratings is poor even in those topic areas instructors consider crucial to successful performance in an electronics rating. Therefore, either the course-performance tests do not measure appropriate skills, or the instructors have an inaccurate perception of mathematics requirements.

Recommendations

1. The mathematics requirements in the entire electronics training pipeline should be assessed to ensure that skills and knowledges essential for successful fleet performance and subordinate skills and knowledges that enable the trainee to master essential skills are taught. This effort is currently being conducted by NAVPERSRANDCEN.

2. Instruction should be developed to remedy student mathematics deficiencies in areas identified as a result of the implementation of recommendation #1.

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INTRODUCTION

Problem

To provide skilled maintenance technicians for increasingly sophisticated electronic equipment, specific mathematics skills must be relevant to student performance in Class "A" school electronic courses. Further, the student ability to perform mathematics skills designated as critical to successful course performance must be assessed so that deficiencies can be identified and corrected.

Background

Although the relation between specific mathematics skills and the proficiency of electronics personnel has not been consistent, the history on the subject is replete with recommendations that "electronics personnel need more math." Research in the 1950s and 1960s certainly tends to support the notion that electronics personnel in general lack proficiency in mathematics (Stauffer, 1955; Anderson, 1962; Cox & Montgomery, 1964; Johnson, 1969). For example, Anderson, after testing the basic abilities of electronics technicians (ETs) in powers-of-ten, square root, algebra, logarithms, trigonometric functions, and binary arithmetic, concluded that, although test scores measuring these skills were related to the "A" school grades, they were not related to electronics job proficiency. That conclusion, however, appears to have done little to dissuade those involved in electronics training from the view that more training in mathematics is at last useful as an "enabling skill" to facilitate the learning of job-related skills.

Current studies regarding the relation of mathematics skills to electronics training are needed. Perhaps the most persuasive argument supporting further study stems from the fact that virtually all the research efforts relating mathematics skills to electronics training were done over 10 years ago. With the rapid evolution of electronics technology and associated maintenance procedures within the last 10 years, it may be that the mathematics skills required to perform effectively in electronics maintenance today are significantly different from those required a few years ago. Therefore, NAVPERSRAND-CEN is conducting a project aimed at identifying mathematics skill deficiencies among Navy electronics students. Electronics training programs were selected because mathematics deficiencies are most often cited as a major cause of unsatisfactory student performance in such programs.

The first report issued under this project identified mathematics skills required for successful performance in the Navy electronics "A" schools (Sachar & Baker, 1981). In that effort, instructors in 14 electronics "A" schools (12 basic and 2 advanced) (see Table 1) were asked to assess the importance of 70 mathematical skills within 14 areas for successful electronics course performance; to indicate whether the surveyed skills are prerequisite, reviewed, or taught by the "A" schools; and to state the number and type of performance aids used in each school. The skills were to be rated on a 6-point scale, where 0 = "not required" and 5 = "indispensable."

Table 2, which lists the 70 surveyed skills, shows that 21 do not affect performance in any basic core course (i.e., instructors rated them as either "0" (not required) or "1" (dispensable), and 9 others affected performance in only 1 course. Although the skills rated as affecting performance are generally considered as prerequisite in all schools, many students require review in these skills for successful performance. Across all schools, the most important skills are (1) addition, subtraction, multiplication, and division of numbers, (2) squares and square roots of positive numbers, (3) addition and subtraction of like units, (4) multiplication and division of like and/or unlike units, (5) substitution of

known values into a given formula, and (6) transpositions of algebraic expressions. Performance aids are permitted in all courses but one, both during the course and during exams.

Purpose

The purpose of this effort was to compare the mathematics skills of entering and graduating electronics "A" school students and to determine how mathematics scores relate to course performance.

Table I

Class "A" Courses Included in Survey

Class "A" Courses	Location
Aviation Electrician's Mate (AE)	Memphis
Avionic Technician (AV)	Memphis
Advanced First Term Avionics (AFTA)[a]	Memphis
Construction Electrician (CE)[b]	Gulfport
Construction Electrician (CE)[b]	Port Hueneme
Data Systems Technician (DS)	Mare Island
Electricians Mate (EM)	Great Lakes
Electronics Technician (ET)	Great Lakes
Electronics Warfare Technician (EW):[c]	
EW Corrective Maintenance (EWC)	Pensacola
EW Preventive Maintenance (EWP)	Pensacola
Fire Control Technician I (FTI)	Great Lakes
Fire Control Technician II (FTII)[a]	Great Lakes
Gunner's Mate (GM)	Great Lakes
Sonar Technician (ST)	San Diego

[a]These are advanced courses attended only by students who rank academically in the upper two thirds of their respective basic core courses.

[b]Two locations of the CE school were surveyed and treated independently to determine whether instructor responses were consistent across locales.

[c]Data were obtained separately for the preventive and corrective maintenance sections of the EW school since each section represented a distinct block of instruction taught by different instructors.

Table 2

Skills Identified as Being Related to Peformance at Navy Electronics Class "A" Schools

Area/Associated Skills	No. of Basic Core Courses Where Skill was Rated as Affecting Performance
Arithmetic Operations with Numbers (4):	
1. Addition, subtraction, multiplication, and division of numbers	12
2. Squares and square roots of positive numbers	11
3. Powers and roots of positive numbers greater than squares and square roots	1
4. Percentages of numbers	11
Estimation (1):	
5. Estimation of answers to arithmetic computation	6
Fractions (5):	
6. Addition and subtraction of fractions	9
7. Multiplication and division of fractions	8
8. Powers and roots of fractions	1
9. Reduction of numeral fractions to lowest terms	6
10. Simplification of complex fractions	4
Units and Conversions (7):	
11. Addition and subtraction of like units	12
12. Multiplication and division of like units	12
13. Multiplication and division of unlike units	12
14. Squares and square roots of units	6
15. Unit conversion between nonmetric and metric systems	1
16. Unit conversion within a metric system	10
17. Unit conversion within a nonmetric system	9
Scientific Notations (4):	
18. Representation of numbers in scientific notation	8
19. Addition and subtraction of numbers in scientific notation	8
20. Multiplication and division of numbers in scientific notation	7
21. Powers and roots of numbers in scientific notation	4
Decibels (1):	
22. Decibels	4
Logarithms (4):	
23. Logs and antilogs found from log tables	3
24. Arithmetic computation using logs	1
25. Solution of logarithmic and exponential equations	3
26. Logs of numbers to bases other than 10, using base 10 log tables	0
Equations (6):	
27. Substitution of known values into a given formula	11
28. Transpositions of algebraic expressions	11
29. Application of transpositions on equations with more than one variable	7
30. Solutions of quadratic equations	0
31. Solutions of second-order simultaneous equations	1
32. Solutions of third-order simultaneous equations	0

Table 2 (Continued)

Area/Associated Skills	No. of Basic Core Courses Where Skill was Rated as Affecting Performance
Algebraic Expressions (9):	
33. Addition and subtraction of algebraic expressions	1
34. Multiplication and division of simple algebraic expressions	0
35. Multiplication of algebraic expressions up to binomials	1
36. Multiplication of algebraic expressions larger than binomials	0
37. Division of algebraic expressions	0
38. Powers and roots of simple algebraic expressions	0
39. Powers and roots of polynomials	0
40. Addition and subtraction of fractional algebraic expressions	0
41. Factoring algebraic expressions	0
Determinants (2):	
42. Evaluation of determinants	0
43. Solutions of simultaneous equations using determinants	0
Geometry and Trigonometry (8):	
44. Conversion of radian and degree measures of angles	0
45. Pythagorean theorem	3
46. Use of trigonometric tables to find specified function of a given angle or the angle of a given function	6
47. Solutions to right triangles	2
48. Calculations of the area of a given triangle	0
49. Solutions for unknown parts of a nonright triangle using laws of sines or cosines	0
50. Solutions of amplitude, frequency, phase angle, period, and angular velocity of a given periodic function	0
51. Amplification of sum and difference identities	0
Phasors (7):	
52. Conversion of polar and rectangular coordinates	2
53. Powers and roots of signed numbers	0
54. Addition and subtraction of phasors in rectangular form	1
55. Addition and subtraction of polar phasors	1
56. Multiplication and division of phasors in rectangular form	0
57. Multiplication and division of polar phasors	0
58. Powers and roots of polar phasors	0
Number Bases (4):	
59. Conversion of numbers to different number systems	5
60. Addition and subtraction in number systems from #59	5
61. Multiplication and division in number systems from #59	5
62. Complements of binary numbers	4
Boolean Algebra (8):	
63. Conversion of Boolean expressions to truth tables	6
64. Conversion of logic diagrams to truth tables	7
65. Conversions of Boolean expressions to logic diagrams	6
66. Simplification of Boolean expressions	2
67. Conversion of logic diagrams to Boolean expressions	6
68. Simplification of Boolean expressions involving minterms (Veitch diagrams)	2
69. Conversion of truth tables to Boolean expressions	5
70. Conversion of truth tables to logic diagrams	5

APPROACH

Test Development

Item Construction

Based on survey results, a test was developed for each basic core course surveyed to assess student performance on skills rated as affecting performance (i.e., above "1"). To determine the number of test items required for each topic or skill area within a course, the ratings or scores assigned to skills rated as affecting course performance were summed to yield an overall skill-importance value and individual scores then converted to percentages of that value. It was assumed that each course test would include approximately 100 items. Thus, the number of items required for any topic/skill was equivalent to the percentage derived from the ratings. Table 3 shows how this procecdure was used for the ET course.

Items were then constructed for each skill affecting performance, using the skill acquisition levels specified by surveyed instructors to determine whether relatively difficult or relatively easy items should predominate, and a number of technical references (Cooke & Adams, 1970; Singer, 1978; Barker & Wheeler, 1978).

The following guidelines were used in writing the test items:

1. A single dimension of the mathematics concept was used as much as possible to obtain unconfounded measures of ability on each mathematics skill requirement. The single dimension criterion could not always be strictly followed. For example, the following item was constructed for Skill 13 (multiplication and division of unlike units):

50 amperes x 3 hours = ________.

The object here is the manipulation of unlike units, not arithmetic computation. In cases where confounding skill was necessary to make a complete and realistic item, it was kept to a minimum level of difficulty.

2. For each skill, items were developed over a range of difficulty. Difficulty arising from item characteristics that were not part of the basic skill (e.g., number of processing steps, transformations, numerical size, etc.) was not used in ordering items along the difficulty dimension. For example, the following items were constructed for Skill 11 (addition and subtraction of like units):

a. 80 milliseconds + 280 milliseconds = ________.
b. 90 millivolts - 0.18 volts = ________.
c. 50 micro-ohms + 1000 micro-ohms - 0.05 ohms = ________.

Item a is inherently more difficult than Item b because of the added unit transformation knowledge and processing requirement. Item c is inherently no more difficult than Item b, but has more steps.

3. Common electronics or scientific terms were used as much as possible for the units and conversions skills. Where focus was on proper manipulation of units, problem set-up and results involving unfamiliar forms (e.g., amperes) were used only to emphasize the manipulation aspects of the problem.

Table 3

Determination of Electronic Technician Course Item Requirements

Skill No. (from Table 1)	Instructors' Importance Ratings	Percent of Sum of Ratings	Items Required
1	5	4.9	5
2	5	4.9	5
4	4	3.9	4
5	3	2.9	3
6	2	1.9	2
11	5	4.9	5
12	5	4.9	5
13	4	3.9	4
15	2	1.9	2
16	5	4.9	5
17	3	2.9	3
18	4	3.9	4
19	4	3.9	4
20	4	3.9	4
21	4	3.9	4
22	3	2.9	3
27	4	3.9	4
28	4	3.9	4
29	4	3.9	4
46	3	2.9	3
59	3	2.9	3
60	3	2.9	3
61	3	2.9	3
63	3	2.9	3
64	3	2.9	3
65	2	1.9	2
67	3	2.9	3
69	3	2.9	3
70	2	1.9	2
Sum of Ratings	102		

4. The most common notation was used in formulating the questions. For example, in Skill 2 (squares and square roots of positive numbers), the square root of 81 can be expressed as $81^{1/2}$ or $\sqrt{81}$. The latter is the preferred notation.

5. Items having only one possible answer were used. Because of the free-response format, it was considered desirable to have precisely defined answers. Where this was not possible (e.g., Skill 5, estimation of answers to arithmetic computation), a range of acceptable answers was generated for each item.

Within a skill area, items were ordered from simple to difficult. Areas were also presented in increasing difficulty. "Arithmetic Operations and Numbers," was considered the easiest; and "Boolean Algebra," the most difficult.

Pilot Test, Item Selection, and Revision

After the preliminary tests were constructed, they were pretested on several engineering students from the University of California at Los Angeles (UCLA). This testing served to identify items that should be revised before the large-scale pretesting scheduled to be conducted in February 1979 at the Fleet Anti-Submarine Warfare Training Center Pacific (FLEASWTRACENPAC), San Diego. For example, one problem was the excessive computation required by many items. The UCLA test also provided a rough estimate of what could be expected for test administration times.

FLEASWTRACENPAC pretesting was conducted largely with sonar technician students waiting to enter Class "A" school, plus a small number who had just completed "A" school or were Basic Electricity and Electronics (BE/E) school graduates. The pretesting was conducted in 5 half-day sessions. At the start of each session, students were given a mathematics self-rating form and instructed to rate their knowledge or ability to solve problems in Boolean algebra, phasors, decibels, number bases, geometry and trigonometry, logarithms, and units and conversions on a 6-point scale ranging from "No knowledge of this area" to "Very good understanding and proficiency in this area; able to deal with complex and difficult problems." Students were not asked to rate themselves on arithmetic operations, estimation, fractions, scientific notations, and equations since it was assumed that students who were entering or who had completed Class "A" school had been exposed to instruction in these topics in high schools and post-secondary schools. Students who rated their knowledge on the most difficult areas as average or above average were given the test on these areas. Those who rated their knowledge as below average were tested on the more familiar areas. Table 4 shows the total number of students taking part in the pretest; and Table 5, the numbers tested on the various topics.

Table 4

Pretest Sample Sizes by Session

Session	Students			Total
	Pre "A" School	Post "A" School	Post BE/E	
1	24	12	5	41
2	18	6	9	33
3	11	9	2	22
4	55	25	6	86
5	72	18	16	106
Total	180	70	38	288

Table 5

Pretest Sample Sizes by Topic

Topic	N
Boolean Algebra	27
Phasors	24
Decibels	22
Number Bases	35
Geometry/Trigonometry	55
Logarithms	25
Units and Conversions	48
Arithmetic Operations	139
Estimation	149
Fractions	143
Scientific Notations	80
Equations	86

Development of Final Test Forms

Selection of items to be included in the final test forms was based on the results of the pretest data analysis. Item-test correlations and percent of students passing each item were computed to assess reliability and difficulty of individual items. The internal consistency reliabilities of items within skill-level and topic-level were calculated prior to and following item selection to help assess the effect of deleting items that were outside the acceptable range of reliability and difficulty.

After the data analyses were completed, individual mathematics tests were constructed for the "A" school electronics courses. The primary considerations in developing these tests were: (1) ensuring that they reflected the instructors' importance ratings of mathematics skills and that the number of items selected were appropriate for 2-hour tests, (2) providing reliable measures of the relevant mathematics skills over a reasonable range of item difficulty, and (3) presenting the items in a suitable format and progressive order of difficulty.

Within each skill, items were selected and ranked on the basis of their item and skill correlations and difficulty levels. An item was considered to be in the acceptable range of difficulty if between 20 and 90 percent of students answered the item correctly (the more desirable limits were considered to be 30 and 80). The minimum acceptable level of discrimination was determined for the .05 significance level. In almost every case, there was a sufficient number of item and skill correlations above this minimum. The item and skill correlation value was the primary consideration in selecting items, but tradeoffs were made to obtain a broad range of item difficulty within the limits indicated above.

A check was made on the actual time required to solve the different types of mathematics items. Once the time was established for each mathematics topic, the preliminary item requirements for each course were reexamined to determine whether the proposed item sets would fit a 2-hour test. Three of the courses fit within the 2-hour time constraint, and the remaining courses were brought within the 2-hour limit by

reducing the number of test items (in proportion to the skill-area importance ratings) by whatever factor was necessary to bring the total test within the 2-hour time limit.

To permit skill comparisons among different courses, common items were used for each skill across all courses requiring that skill. For example, all tests using three items to measure a particular skill used the same three items; tests requiring four items for the skill used the three course items plus a common fourth item, and so on. Thus, it was important to decide the order in which items would be selected for inclusion in the final tests. For this purpose, items within each skill area were placed in rank order on the basis of item discrimination and item difficulty, with item discrimination generally given precedence over difficulty. The final order of the items for each skill was adjusted to present the easiest of the common items first.

Using these rank-ordered item listings and the course item requirements shown in Table 6, nine individual mathematics skills tests were constructed.[1] (A single test was developed for use at the two CE schools, since mathematics skill ratings for the two schools were very similar and anticipated student samples were rather small.) The process was simply to select items for each skill based on their rank order; the highest-ranked item for the skill was chosen first, etc., until the required number of items had been selected.

Test Administration

Test administration began in May 1979 and continued over a period of 14 weeks. To minimize selection factors and ensure that the tested sample would be representative of the general population of students in these courses, an attempt was made to include all students entering or graduating from the designated courses during the scheduled testing period. "Entering students" were those who were starting the first day of the course and had not yet received formal classroom instruction. "Graduating students" were those who were in the final week of the course or had just graduated from the course and had received no postgraduation instruction or training (except for those in the 6-month DS course, who had to be tested during the last 2 weeks of instruction).

All the testing was conducted by the contractor, except for the CE school at Gulfport where the CE school instructors administered the tests to the last 9 of the 14 entering students in the CE sample. Since classes were tested as intact units, foreign students who were present on the day of testing were given the mathematics tests, although the study design called for testing only U.S. students. (Test data on foreign students were eliminated from the data analyses.) To minimize the demands of conflicting duties and responsibilities, testing was conducted whenever possible during regular classroom hours. Since the EM school schedule did not permit testing during the school day, tests were conducted after hours.

At the start of each testing session, students were given a brief description of the study objectives. In general, the students took the project seriously and worked as hard as one might expect in a mathematics test situation. The "A" school instructors and administrative personnel were very helpful in coordinating the various testing sessions and encouraging students to their maximum effort. The numbers of students tested at each of the schools is shown in Table 7.

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[1]A test was not developed for the ST rating under this contract because of the differences in the training sequence between STs and the remainder of the "A" school participants.

Table 6

Item Requirements for Class "A" School Basic Core Electronics Courses

Topic/Skill	Number of Items Required for Each Course								
	AE	AV	CEG/ CEP	DS	EM	ET	EW	FT	GM
Arith. Ops.									
1	10	3	11	4	5	4	5	6	8
2	4	3	7	-	5	3	-	5	3
3	-	-	-	3	-	-	-	-	-
4	8	3	8	-	5	3	5	5	4
Estimation									
5	4	3	4	3	-	3	-	-	-
Fractions									
6	6	-	5	-	3	3	3	-	3
7	6	-	5	-	3	-	3	-	3
9	-	-	5	-	5	-	3	-	3
10	-	3	-	-	3	-	3	-	-
Units/Conv.									
11	8	3	7	4	5	4	5	5	4
12	8	3	7	4	5	4	5	5	3
13	8	3	8	3	4	3	5	5	4
14	-	3	-	-	5	-	5	-	3
15	-	-	-	-	-	3	-	-	-
16	7	3	5	3	5	4	5	5	-
17	4	3	6	-	-	3	5	5	4
Sci. Not.									
18	-	3	-	4	5	3	4	5	-
19	-	3	-	4	3	3	4	5	-
20	-	3	-	3	-	3	4	3	-
21	-	-	-	-	-	3	3	-	-
Decibels									
22	-	-	-	-	-	3	4	-	-
Logarithms									
23	-	-	-	-	-	-	5	-	-
25	-	-	-	-	-	-	5	-	-
Equations									
27	6	3	8	-	5	3	5	4	8
28	6	3	8	-	5	3	5	5	6
29	6	-	-	-	5	3	4	-	6
Geom./Trig.									
45	-	-	7	-	5	-	-	-	-
46	8	-	-	-	5	3	-	5	-
47	-	-	-	-	-	-	-	5	-
Phasors									
52	-	-	-	-	-	-	-	5	-
54	-	-	-	-	-	-	-	5	-
55	-	-	-	-	-	-	-	5	-
Number Bases									
59	-	3	-	4	-	3	-	-	-
60	-	3	-	4	-	3	-	-	-
61	-	3	-	4	-	3	-	-	-
62	-	3	-	4	-	-	-	-	-
Boolean Alg.									
63	-	3	-	4	-	3	-	-	6
64	-	3	-	4	6	3	-	-	6
65	-	3	-	4	-	3	-	-	6
66	-	-	-	4	-	-	-	-	-
67	-	3	-	4	-	3	-	-	6
68	-	-	-	4	-	-	-	-	-
69	-	3	-	4	-	3	-	-	-
70	-	3	-	4	-	3	-	-	-
Total	99	78	101	83	92	91	95	88	86

Table 7

Mathematics Test Sample Sizes

Course	Entering Students	Graduating Students	Total	Number of Classes Tested
AE	158	165	323	17
AV	157	168	325	16
CEG	14	20	34	4
CEP	29	29	58	4
DS	70	77	147	12
EM	159	222	381	11
ET	156	196	352	20
EW	56	56	112	12
FT	165	154	319	7
GM	96	152	248	18
Total	1060	1239	2299	121

Data Collection

To assess the relation of mathematics skills to "A" school performance, a variety of aptitude and "A" school information was collected:

1. Student Aptitude Scores. Standard ASVAB scores were obtained for both entering and graduating students in the test sample. In addition, College Level Examination Program (CLEP) mathematics test scores were obtained for students in the DS course.

2. Measures of Overall Course Performance. For graduating students, scores were obtained on both written and practical "A" school examinations. In cases where "A" school performance was measured by comprehensive midterm and final examinations, item data were obtained for these exams. In cases where performance was measured by weekly or sectional examinations, total scores were collected for each exam.

3. Measures of Performance in the Mathematics-Related Portions of the Course. For courses where item data were obtained for comprehensive examinations, each item was classified as mathematics or nonmathematics in content. Based on these categorizations, new scores were computed for each individual on the mathematics-related and nonmathematics-related items. Where weekly or sectional examinations were used, examinations were identified by content area to permit separate analyses of different areas.

RESULTS

Mathematics Test Reliabilities

The mathematics tests for each "A" School were analyzed to provide internal consistency-reliability coefficients (KR-20s) for the total test and topic scores, and to determine topic and total correlations based on these scores.

Reliabilities for School Mathematics Tests

Table 8[2] presents the total mathematics test KR-20s for the entering and graduating groups and for the combined sample. As shown, the KR-20s range from .90 to .97 for entering students, .92 to .97 for the graduating students, and .91 to .97 for the total group. These results indicate that the mathematics tests for all the schools have strong internal consistency reliability.

Correlations of Mathematics Topic Scores with Total Mathematics Test Scores

A second way of looking at reliability is to evaluate the relationship of the individual topics to the total test. As shown in Table 9, most of the topic and total correlations were moderate to high in size. The highest topic and total correlations for the graduating students were Arithmetic Operations (.35 to .95), Units and Conversions (.60 to .91) and Equations (.53 to .91). The lowest topic and total correlations were observed for Phasors (.37), Estimation (.41 to .73), and Decibels (.35 and .41). Mathematic aptitude is presumably basic to all the topics and hence the appearance of the moderate correlations. There was sufficient variance remaining to distinguish between the contribution of the various mathematical topics to course performance.

Table 9 also includes correlations between total scores and ASVAB. The ASVAB tests that might be expected to correlate with total scores are Arithmetic Reasoning (AR), Numerical Operations (NO), and Mathematics Knowledge (MK). As shown, correlations with AR and MK scores were moderate to moderately high (.37 to .66) for the CE, EM, ET, EW, and GM schools.

Entering and Graduating Student Test Scores

Comparison of Total and Topic Test Scores

The same mathematics skills tests were given to the entering and graduating students within each course, permitting direct comparisons between the two groups in each school. However, there were differences among the "A" Schools' mathematics skill tests in numbers of items within a mathematics skill area and in the combination of mathematics topics and skill areas. Comparisons across schools, therefore, should take into account differences in the mathematics topic compositions.

As shown in Table 10, across all schools, the mean percent correct on the total test ranged from 29 to 41 percent for entering students and 29 to 60 percent for graduating students. The mean percent correct on topic areas rated as critical to successful course performance ranged from 0 to 75.8 (Table 11).

Mathematics test scores can be attributed both to mathematics ability acquired prior to "A" School and to "A" school training. Thus, to determine the effect of training alone at the various schools on the mathematics test results, the entering and graduating student groups were equated on their mathematics abilities. At each school, an ANOVA was performed that adjusted mathematics test scores by equating the two groups on three covariates: ASVAB AR, NO, and MK scores. The resulting F-ratios (Table 12) show the significance of difference between the entering and graduating students on each mathematics topic and the total test when scores have been adjusted.

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[2]Because of the large number of tables in this section relative to the amount of text, the tables appear at the end of the section, beginning on page 19.

The t-test was applied to the differences between the mean scores of entering and graduate students. Table 13 presents results, as well as a comparison between the two groups as to level of acquisition. If a given skill was reviewed (R) or taught (T) at a school, a significant difference between the entering and graduating group mean scores on that skill would be expected. On the other hand, if a skill was a prerequisite (P) for the course and no further review was involved, no significant difference between groups would be expected. Table 14 provides ASVAB scores for the two groups. Differences in mean test scores and ASVAB scores are discussed below:

1. AE School

a. Mathematics Test Scores. There were no significant differences between the entering and graduating AE student mean scores on any of the mathematics test topics. This result is congruent with the fact that the instructors considered most of the skills tested as prerequisites for the course. Only three (Skill 6 in Fractions, Skill 29 in Equations, and Skill 46 in Geometry and Trigonometry) were considered as subjects for review. When AE entering and graduating students were equated on AR, NO and MK, the differences in mathematic test topic and total scores were still not significant.

b. ASVAB Scores. There were no significant differences between entering and graduating student ASVAB scores.

2. AV School

a. Mathematics Test Scores. As would be expected, training in the Number Bases and Boolean Algebra topic areas produced very significant differences between the entering and graduating AV student groups. Skill 10 in Fractions, Simplification of Complex Fractions, a prerequisite reviewed during the course, also showed a significant difference between groups. The instruction on Skill 16, Unit Conversion within a Metric System, apparently was not sufficient to produce a significant difference between groups in total topic proficiency. Similarly, the review of several other skills did not produce significant differences between the groups. When entering and graduating students were equated on AR, NO, and MK, the above results still held.

b. ASVAB Scores. The entering and graduating student groups showed no significant difference on any of the ASVAB variables. Differences between AV groups on the mathematics tests can be attributed to differences in training rather than differences in aptitude.

3. CEP/CEG Schools

a. Mathematics Test Scores.

(1) CEG. All mathematics skills tested in the CEG school were considered prerequisites for the course; two Units and Conversions (Nos. 11 and 12) were prerequisites but reviewed in the course. The results for the 14 entering and 20 graduating students at the CEG school at Gulfport were unexpected. There was a general drop in mean test scores between entering and graduating students, with significant differences in the Units and Conversions and Equations topics. When the entering and graduating groups were equated on AR, NO, and MK, these results were replicated, and, in addition, the difference between the CEG groups in their total mathematics scores reached significance. The anomalous results probably followed from the small sample numbers and the atypical sampling and testing procedures necessarily used at the CEG school. Because of the low enrollment and sporadic class scheduling, some of the sample had to be tested

on an individual basis by school personnel and over an extended period of time. The great disparity between the CEP mean total and the CEG mean total scores points to the probability that CEG test scores underestimate the true values for graduating students.

(2) At the CEP school, one Arithmetic Operations, one Estimation and three Units and Conversions skills were considered prerequisites. One Geometry/Trigonometry skill was taught, and the remaining skills considered essential were reviewed. Although the mathematics topic means for the entering and graduating students at CEP did not differ significantly, differences in the total test means were in the expected direction (40.2 for entering vs. 42.8 for graduating students). These results were repeated when the CEP groups were equated on AR, NO, and MK.

b. ASVAB Scores. There were no significant differences in the ASVAB mean scores between the entering and graduating student groups at either of the two CE schools. Therefore, aptitudes, especially those that are math-related (AR, NO, and MK) would not account for the differences on the mathematics test performance observed between the two CE schools with respect to entering and graduating groups' relative achievement.

4. DS School

a. Mathematics Test Scores. Number Bases and Boolean Algebra skills are taught in the DS School, and, as expected, graduating students scored significantly higher than entering students in these areas. There were no significant differences between the groups for mathematics skills in Arithmetic Operation and Estimation, although both of these topics were reviewed in the school. However, entering students scored significantly higher on Units and Conversions and Scientific Notation skills, which may indicate that the entering student group had had prior or recent training on these skills. All the significant differences indicated above were corroborated when the groups were equated on their AR, NO, and MK scores.

b. ASVAB Scores. In most aptitude areas measured by the ASVAB, entering and graduating students appear to be very similar. However, a significant difference was found on the MK Mathematics Knowledge subtest, with the mean for graduating students approximately 1.5 standard scores points higher than that of the entering students.

5. EM School

a. Mathematics Test Scores. There were no significant differences between mean scores for entering and graduating students except for Boolean Algebra (the only mathematics skill taught in the course). Although all the other topics pertinent to the EM school contain skills that were presumably reviewed in the course, there were no significant gains in tested mathematics proficiency in any of these topics. The difference found for Boolean Algebra is of statistical significance but of negligible practical significance; the significant difference between means for this topic rests on the fact that the mean score for entering students in Boolean Algebra was zero, and the mean score for graduating students was 0.2. Whether this slight amount of skill acquisition is sufficient for EM course purposes would be best answered by a detailed curriculum study.

When EM entering and graduating students were equated on AR, NO, and MK, the result for Boolean Algebra was confirmed. The F-ratio for the Arithmetic Operations topic also showed a significant difference ($p \leq .05$) between the two groups.

b. ASVAB Scores. There were three significant ASVAB mean score differences between the EM entering and graduating groups: on Word Knowledge (WK), AR, and Automotive Information (AI). On all three tests, the entering student group had the highest mean scores. The actual differences were about 2 points for WK and AR, and 2.5 points for AI. These were not large differences and, except for the Arithmetic Operations topic, probably did not have a strong influence on the mathematics test results or on the "A" school performance data. The AR difference between the groups was not supported by the MK and NO mean differences.

6. ET School

a. Mathematics Test Scores. The review or instruction of the mathematics topics in the Electronics Technician courses appeared to be highly successful if the significantly higher scores for the graduating students on all but three of the mathematics tests can be considered criteria for achievement. Both groups were similar in their performance on Estimation, Fractions, and Geometry/Trigonometry, but the graduating students' mean scores were significantly higher on the remaining eight topic tests. However, when the two groups were equated on AR, NO, and MK, the number of significant differences was reduced. The gain by the graduating students held only for Decibels, Number Bases, and Boolean algebra.

b. ASVAB Scores. Comparison of the entering and graduating student ASVAB scores revealed a variety of results. Some of the significant differences found were appreciable, indicating that the two school groups did not closely resemble each other in abilities. The entering students as a group scored significantly higher than the graduating students on WK, Attention to Detail (AD), Shop Information (SI), AI, and General Information (GI). The graduating students had significantly higher scores on Electronics Information (EI) and MK. This finding, suggesting that an interaction between MK and training at the ET school resulted in the higher mathematics test scores, was supported by results of the analysis of covariance.

7. EW School

a. Mathematics Test Scores. The EW graduating students scored higher than did the entering students on all the mathematics topic tests pertinent to the EW school--significantly so for Scientific Notation, Decibels, Logarithms, and total score. These results were expected, since all topics were either taught or reviewed at the EW school. The analysis of covariance supported these findings and added Equations to the list of mathematics topics where the graduating students scored significantly higher.

b. ASVAB Scores. In general, entering and graduating students did not differ significantly on the ASVAB tests. Exceptions were AR and Mechanical Comprehension (MC), on which the graduating students had significantly higher mean scores, and AD and NO, on which the entering students had the higher scores.

8. FT School

a. Mathematics Test Scores. Although the mathematics topics tested were all reviewed or taught in the FT school, there were no significant differences between entering and graduating students on any topics. Equating the students on the covariances did not change these results.

b. ASVAB Scores. There were no significant differences between entering and graduating students on any of the ASVAB subtests.

9. GM School

a. Mathematics Test Scores. Skills involved in three of the mathematics topics pertinent to the GM school were taught: Units and Conversions (Skill 17), Equations (Skills 28 and 29), and Boolean Algebra (Skills 63-67). Of these, only Boolean Algebra showed a significantly higher mean score for the graduating students. The entering students had a significantly higher mean score for Units and Conversions. The analysis of covariance supported both findings. The topics reviewed rather than taught also showed mixed results, the entering students more often achieving the higher mean score. The assumption that topics were taught or reviewed during the course is based on survey results gathered prior to this study. If the curriculum did not, in fact, include the teaching and review of the mathematics topics indicated, the mixed results might be accounted for.

b. ASVAB Scores. There were no significant differences between the entering and graduating students on their ASVAB scores.

Correlation Analyses

Intercorrelations were computed between all variables of interest in this study: mathematics test total and topic scores, the ASVAB tests, and "A" school written and practical examinations. A correlation matrix was developed for each school and for each student group separately, with intercorrelations obtained between mathematics tests and ASVAB for the entering and graduating groups, and intercorrelations between "A" school data and the other variables for the graduating students. The correlation matrices are discussed below.

1. AE School. The AE school performance measures consisted of seven practical exams (P_1 to P_7) and two forms of a written final (W_1 and W_2) (Table 15). As shown in Table 15, the correlations between the total mathematics test and AE performance measures ranged from low (.06) to moderately high (.41). The correlations obtained between the total test and P_4, W_1, W_2, and nonmath 2 were significant at the .01 level. Except for Geometry/Trigonometry, the mathematics topic scores of AE students showed the same pattern of correlations with performance measures as did the total test.

The intercorrelations of the AE school performance measures were generally low, except for the correlation between P_6 and W_2. Evidently this form of the written final examination had more in common with P 6 than did W_1.

In general, the ASVAB tests were not strong predictors of AE school performance. Moderate correlations were obtained for WK with W_1, W_2, and nonmath 2; MC with W_1; AD with W_2, and nonmath 2; General Science (GS) with W_2 and nonmath 2; and Space Perception (SP) with W_2 and nonmath 2.

2. AV School. There were some significant but moderately low relationships between AV school measures and the mathematics tests, and between school measures and ASVAB tests (Table 16).

3. CEG School. As shown in Table 17, the total mathematics test scores had moderately high correlations with most of the CEG performance measures. The CEG measures best predicted by mathematics topics were power, sub. math, practical, and nonmath. The Geometry/Trigonometry topic correlated highest with CEG performance.

The best ASVAB predictor of CEG performance was MC, which was highly correlated with all of the performance measures. SI and GI were also good correlates of CEG performance, with coefficients ranging from moderate to high.

In the main, the five CEP performance measures were highly intercorrelated.

4. CEP School. CEP held six examinations, including a written final (Table 18). The total mathematics test showed moderate to high correlations with all CEP performance measures except pole, cubicle, and math. The CEP power, wire, and final examinations measures were those best predicted by the mathematics topics. Although Estimation and Equations topics showed the highest correlations with performance measures, Equations correlated negatively (-.38) to the CEP mathematics items in the final exam. However, since item data were obtained for only 14 of the 29 students taking the final exam, this negative correlation may not be representative of the entire group.

The intercorrelations of the CEP performance measures were moderate to high, except that the mathematics section of the final exam (two items out of 100) correlated negatively with all the other performance measures, and the practical exams on wire, communications, and cubicle correlated either low or negatively with the final exam.

In general, ASVAB tests had low to moderate correlations with CEP performance. The power and final exams were better predicted by ASVAB than were the other performance measures. MC, SI, and MK showed moderate correlations with most performance criteria. The highest correlation, .57, was between NO and the nonmath items in the final exam.

5. DS School. The total mathematics score, as well as Estimation, Scientific Notation, Units and Conversions, Number Bases, and Boolean Algebra topics were highly related to the DS performance measures (Table 19). Moderate correlations with CLEP scores were obtained for the lab total, written total, and final total performance measures. ASVAB tests had generally low correlations with the DS performance measures.

6. EM School. The EM school performance measures consisted of one practical and one written final exam (Table 20). There were six mathematics-related questions on the 60-item final exam. The total test correlated moderately with the written exam (.43) and with the nonmath part of the written exam (.38). The mathematics topics had low correlations with the EM practical exam and low to moderate correlations with the written exam. Units and Conversions, Scientific Notation, Equations, and Geometry and Trigonometry topics correlated most highly with the EM written final exam and its nonmath portion.

The EM performance measures had low intercorrelations. The written exam correlated .95 with its large nonmath content.

The correlation of ASVAB tests with the practical exam tended to be low, except for EI and SP. Somewhat better ASVAB prediction was seen for the written exam, especially for MC, EI, and MK.

7. ET School (Table 21). The correlations of the mathematics total test and topics with the sum lab measure were generally moderate to high, especially for Units and Conversions, Decibels, and Scientific Notation. The correlations between the total test and topics with the ET written exam, however, were very low.

The correlation of the written and laboratory measures was moderate in size. The correlations of ASVAB tests to ET measures were very low for the written exam, except for SP, and low to moderate for the laboratory measure. The best ASVAB predictors of the lab grade were MC, MK, GI, and AI.

8. EW School. The correlations of the seven EW performance measures with the total mathematics test scores ranged from moderate to very high (Table 22). Arithmetic Operations, Fractions, Units and Conversions, Scientific Notation, Logarithms, and Equations all accounted for moderately high to high correlations with EW measures. The EW performance scores that showed the highest relation to mathematics test topics were mathematics 11, final 11, and mathematics 12.

Nonmathematics questions comprised approximately 20 percent of each of the three written final exams. Logarithms, Equations, Units and Conversions, and Math Total had moderate correlations to the nonmathematics portion of final 11, but the mathematics test and topics tended to correlate poorly with nonmathematics 12 and 13.

9. FT School. The correlations of FT performance measures with mathematics total test and topics ranged from low for practical exams to moderate for written exams, and were highest for the "average total" FT performance score (Table 23). Total test score, Units and Conversions, Scientific Notation, and Geometry and Trigonometry had the highest correlations with the FT performance scores. The combined FT midterm and final exams (written 1 and 2) had 150 nonmathematics questions out of 160. The correlations of total test and topics with the nonmathematics portion were generally moderate in size. Units and Conversions, Scientific Notation, and Geometry and Trigonometry were the strongest predictors of the nonmathematics part of the written exams. The correlations with the miniscule part of the exams that had mathematics content tended to be moderate in size, but lower than those for the nonmathematics parts.

The intercorrelations of the FT measures ranged from low (practical tests with written tests) to high (written 1 with averaged total). The correlations of the ASVAB tests with the FT measures were generally very low.

10. GM School. The correlations of GM school performance measures with the total mathematics and mathematics topics were low to moderate in size (Table 24). Total test and Arithmetic Operations had the highest correlations with performance. The GM practical and written exams correlated moderately highly with each other. The relation betwen ASVAB tests and GM measures were low to moderate, with GI proving to be the best ASVAB predictor of the GM written exam.

Table 8

Total Test Reliabilities (KR-20) Across Schools

School	# Items	Entering Sample	Graduating Sample	Total Sample
AE	99	.93	.93	.93
AV	78	.90	.93	.93
CEG	101	.96	.94	.95
CEP	101	.95	.97	.96
DS	83	.93	.92	.93
EM	92	.97	.97	.97
ET	91	.94	.94	.95
EW	94	.95	.93	.94
FT	88	.94	.94	.94
GM	86	.91	.92	.91

Table 9

Correlations of Graduates' Math Skills Total Scores With Math Topics and ASVAB Scores

Item	AE	AV	CEG	CEP	DS	EM	ET	EW	FT	GM
Math Topics										
Arith. Ops.	.35**	.63**	.95**	.92**	.51**	.78**	.62**	.60**	.78**	.71**
Estimation	.73**	.40**	.42	.53**	.33**	--	.41**	--	--	--
Fractions	.85**	.63**	.85**	.67**	--	.83**	.41**	.83**	--	.68**
Units & Conv.	--	.84**	.66**	.91**	.60**	.91**	.73**	.86**	.86**	.76**
Sci. Not.	--	.67**	--	--	.75**	.81**	.78**	.70**	.80**	--
Decibels	--	--	--	--	--	--	.35**	.41**	--	--
Logarithms	--	--	--	--	--	--	--	.72**	--	--
Equations	.76**	.71**	.53*	.86**	--	.91**	.70**	.70**	.76**	.88**
Geom./Trig.	.51**	--	.42	.61**	--	.79**	.46**	--	.75**	--
Phasors	--	--	--	--	--	--	--	--	.37**	--
No. Bases	--	.70**	--	--	.65**	--	.58**	--	--	--
Boolean Alg.	--	.70**	--	--	.82**	.37**	.79**	--	--	.56**
ASVAB Scores										
WK	.12	.14	.14	.23	.14	.46**	.29**	.25	.08	.18*
AR	.24**	.34**	.57*	.47*	.35*	.62**	.37**	.49**	.17*	.49**
MC	.03	.11	.33	.46*	.06	.40**	.27**	.23	-.11	.08
AD	.09	.27*	-.39	-.21	.04	.14	.28**	-.02	-.07	-.05
NO	.31**	.29*	.00	.30	.06	.40**	.09	.16	-.01	.14
SI	-.01	-.03	.17	.15	-.06	.19*	.15*	-.02	.05	-.01
EI	-.09	.01	.13	.15	.13	.41**	.16*	-.05	.10	.23**
MK	.36**	.42**	.54*	.60**	.43**	.66**	.55**	.65**	.20*	.55**
GS	.08	.14	.40	.27	.27	.43**	.24**	-.09	-.08	.19*
GI	.04	-.02	.22	.17	.13	.39**	.22**	.25	.15	.13
SP	-.02	.14	.05	.16	.19	.36**	.11	.26	-.20	.12
AI	.01	-.14	.18	-.02	-.01	.20*	.14*	.01	-.01	.05

$^{*}p \leq .05$.
$^{**}p \leq .01$.

Table 10

Mean Scores and Mean Percent Correct by School on Total Tests

School	N	Mean Score	X % Correct	Number Items
		Total Students		
AE	323	38.87	39	99
AV	325	32.89	42	78
CEG	58	36.00	36	101
CEP	34	41.48	41	101
DS	147	33.22	40	83
EM	381	37.09	40	92
ET	352	46.38	51	91
EW	112	42.91	45	95
FT	319	33.53	38	88
GM	248	24.81	29	86
		Entering Students		
AE	158	39.19	40	99
AV	157	25.16	32	78
CEG	29	42.64	42	101
CEP	14	40.21	40	101
DS	70	25.94	31	83
EM	159	37.69	41	92
ET	156	36.42	40	91
EW	56	38.62	41	95
FT	165	34.48	39	88
GM	96	25.11	29	86
		Graduating Students		
AE	165	38.56	39	99
AV	167	39.18	50	78
CEG	29	31.35	31	101
CEP	20	42.76	42	101
DS	77	39.83	48	83
EM	222	36.67	40	92
ET	196	54.31	60	91
EW	56	47.20	50	95
FT	154	32.52	37	88
GM	152	24.62	29	86

Table 11

Mean Scores and Mean Percent Correct by School on Topic Areas Rated by Instructors as Critical to Successful Course Performance

Topic	Number Of Items	Entering Students Mean Score	Entering Students Mean % Correct	Graduating Students Mean Score	Graduating Students Mean % Correct	Total Mean Score	Total Mean % Correct
AE School							
Arithmetic Operations with Numbers	22	12.37	56	12.44	57	12.40	56
Units and Conversions	35	11.08	32	11.08	32	11.08	32
Total	99	39.19	40	38.56	39	38.87	39
AV School							
Arithmetic Operations with Numbers	9	6.08	68	6.05	67	6.07	6[illegible]
Units and Conversions	18	8.08	46	8.34	46	8.38	47
Scientific Notation	9	2.91	32	2.85	32	2.88	32
Equations	6	3.07	51	3.12	52	3.10	52
Number Bases	12	.69	6	8.10	68	4.52	38
Boolean Algebra	18	1.80	10	8.20	46	5.11	28
Total	78	25.16	32	39.18	50	32.41	42
CEG School							
Arithmetic Operations with Numbers	26	15.21	59	13.40	52	14.15	54
Total	101	42.64	42	31.35	31	36.00	36
CEP School							
Arithmetic Operations with Numbers	26	13.14	51	15.14	59	14.14	54
Equations	16	5.62	35	5.21	33	5.41	34
Total	101	40.21	40	42.76	42	41.48	41
DS School							
Arithmetic Operations with Numbers	7	4.71	67	4.95	71	4.84	69
Units and Conversions	14	6.34	45	4.48	32	5.37	38
Scientific Notation	11	5.27	48	3.84	35	4.52	41
Number Bases	16	5.17	32	11.49	72	8.48	53
Boolean Algebra	32	3.23	10	13.73	43	8.73	27
Total	83	25.94	31	39.83	48	33.22	40
EM School							
Arithmetic Operations with Numbers	15	8.58	57	8.68	58	8.64	58
Units and Conversions	24	8.59	36	8.15	34	8.33	35
Scientific Notation	8	3.51	44	3.02	38	3.23	40
Equations	15	6.75	45	6.55	44	6.64	44
Geometry and Trigonometry	10	2.33	23	2.30	23	2.32	23
Boolean Algebra	6	.00	0	.16	0	.09	2
Total	92	37.69	41	36.67	40	37.09	40
ET School							
Arithmetic Operations with Numbers	10	6.81	68	7.58	76	7.24	72
Units and Conversions	21	9.92	41	11.27	54	10.67	51
Scientific Notations	12	4.58	38	5.69	47	5.20	43
Equations	9	5.84	65	6.63	74	6.28	70
Total	91	36.42	40	54.31	60	46.38	51
EW School							
Arithmetic Operation with Numbers	10	6.68	67	6.95	70	6.81	68
Units and Conversions	30	12.57	42	13.48	45	13.03	43
Scientific Notations	15	4.45	30	6.30	42	5.38	36
Decibels	4	.23	6	1.75	44	.99	25
Logarithms	10	1.12	11	2.66	27	1.89	19
Equations	14	6.57	47	8.00	57	7.29	52
Total	95	38.62	41	47.20	50	42.91	45
FT School							
Arithmetic Operations with Numbers	16	9.89	62	9.16	57	9.53	60
Units and Conversions	25	12.00	48	11.14	45	11.58	46
Scientific Notation	13	4.75	37	4.59	35	4.67	36
Geometry and Trigonometry	10	3.18	32	3.42	34	3.30	33
Phasors	15	.50	3	.38	3	.44	3
Total	88	34.48	39	32.52	37	33.53	38
GM School							
Arithmetic Operations with Numbers	15	8.07	54	8.71	58	8.46	56
Equations	20	5.57	28	4.81	24	5.10	26
Boolean Algebra	24	1.34	6	2.71	11	2.18	9
Total	86	25.11	29	24.62	29	24.81	29

Table 12

Significance of Difference (F-Ratios) in Test Scores When Entering and Graduating Groups are Equated on Mathematics Abilities

	School									
Topic	AE	AV	CEG	CEP	DS	EM	ET	EW	FT	GM
Arithmetic Ops.	.02	.06	.49	.44	.17	4.43*	2.24	.97	2.70	3.20
Estimation	.80	.61	3.22	.00	.10	--	.61	--	--	--
Fractions	.47	7.28**[a]	3.20	2.59	--	.81	3.60	3.49	--	.49
Units & Conv.	.00	.00	12.50**[b]	2.05	16.84**[b]	.38	2.49	2.00	3.17	13.76**[b]
Sci. Notation	--	.03	--	--	10.48**[b]	.06	1.62	4.41*[a]	.00	--
Decibels	--	--	--	--	--	--	130.38**[a]	88.96**[a]	--	--
Logarithms	--	--	--	--	--	--	--	18.57**[a]	--	--
Equations	.97	.23	4.67*[b]	.70	--	2.33	.83	3.94*[a]	1.66	2.48
Geom./Trig.	.02	--	1.39	.01	--	1.03	.25	--	2.50	--
Phasors	--	--	--	--	--	--	--	--	.44	--
Number Bases	--	711.06**[a]	--	--	63.46**[a]	--	346.64**[a]	--	--	--
Boolean Algebra	--	355.52**[a]	--	--	94.72**[a]	8.89**[a]	197.38**[a]	--	--	11.95**[a]
Total Test	.24	143.38**[a]	7.24*[b]	.09	28.73**[a]	2.10	102.23**[a]	10.12**[a]	1.27	.15
Entering N:	142	148	7	18	62	127	143	55	148	81
Graduating N:	157	163	20	29	63	192	186	55	145	139

*$p \leq .05$.
**$p \leq .01$.
[a]Entry level group scored higher.
[b]Graduating group scored higher.

Table 13

Mathematics Test Scores of Entering and Graduating Students

Topic	No. of Items	Skill I.D. Numbers by Acquisition Level[a]			Entering (E) Students		Graduating (G) Students		
		P	R	T	M	SD	M	SD	t
AE School (E = 158, G = 165)									
Arithmetic Ops.	22	1, 2, 4	--	--	12.4	4.9	12.4	4.5	.13
Estimation	4	5	--	--	1.4	1.1	1.4	.9	.66
Fractions	12	7	6	--	5.9	3.5	5.6	3.4	.74
Units & Conv.	35	11,12,13,16,17	--	--	11.1	5.6	11.1	5.6	.01
Scientific Not.	--	--	--	--	--	--	--	--	--
Decibels	--	--	--	--	--	--	--	--	--
Logarithms	--	--	--	--	--	--	--	--	--
Equations	18	27, 28	29	--	6.1	4.4	5.8	4.4	.67
Geometry/Trig.	8	--	46	--	2.3	1.4	2.3	1.4	.09
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	--	--	--	--	--	--	--	--	--
Boolean Algebra	--	--	--	--	--	--	--	--	--
Total Test	99	--	--	--	39.2	15.4	38.6	15.3	.37
AV School (E = 157, G = 168)									
Arithmetic Ops	9	--	1, 2, 4	--	6.0	2.1	6.0	2.4	.04
Estimation	3	--	5	--	1.3	.9	1.2	.9	.75
Fractions	3	--	10	--	.9	1.2	1.3	1.3	2.41*
Units & Conv.	18	--	11,12,13,14,17	16	8.3	3.1	8.3	3.6	.01
Scientific Not.	9	--	18, 19, 20	--	2.9	2.5	2.9	2.6	.24
Decibels	--	--	--	--	--	--	--	--	--
Logarithms	--	--	--	--	--	--	--	--	--
Equations	6	--	27, 28	--	3.1	1.8	3.1	2.0	.35
Geometry/Trig.	--	--	--	--	--	--	--	--	--
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	12	--	--	59, 60, 61, 62	.7	2.1	8.1	2.9	25.69**
Boolean Algebra	18	--	--	63, 64, 65, 66, 67	1.8	2.6	8.2	3.6	18.21**
Total Test	78	--	--	--	25.1	10.2	39.2	13.4	10.55**
CEG School (E = 14, G = 20)									
Arithmetic Ops	26	1, 2, 4	--	--	15.2	6.4	13.4	6.5	.81
Estimation	4	--	--	--	1.6	1.4	1.2	.8	1.19
Fractions	15	6, 7, 9	--	--	8.5	5.0	6.7	4.5	1.10
Units & Conv.	33	11,12,13,16,17	11, 12	--	11.6	5.4	6.8	4.6	2.75**
Scientific Not.	--	--	--	--	--	--	--	--	--
Decibels	--	--	--	--	--	--	--	--	--
Logarithms	--	--	--	--	--	--	--	--	--
Equations	16	27, 28	--	--	5.4	3.8	2.6	3.1	2.32*
Geometry/Trig.	7	45	--	--	.4	1.3	.6	1.0	.59
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	--	--	--	--	--	--	--	--	--
Boolean Algebra	--	--	--	--	--	--	--	--	--
Total Test	101	--	--	--	42.6	19.0	31.4	15.3	1.91
CEP School (E = 29, G = 29)									
Arithmetic Ops.	26	1	2, 4	--	13.1	6.8	15.1	5.4	1.24
Estimation	4	5	--	--	1.1	.8	1.3	1.0	1.13
Fractions	15	--	6, 7, 9	--	8.1	3.8	9.8	3.7	1.72
Units & Conv.	33	11, 12, 13	17	--	10.8	5.6	9.4	8.1	.73
Scientific Not.	--	--	--	--	--	--	--	--	--
Decibels	--	--	--	--	--	--	--	--	--
Logarithms	-	--	--	--	--	--	--	--	--
Equations	16	--	27, 28	--	5.6	4.5	5.2	5.1	.33
Geometry/Trig.	7	--	--	45	1.4	2.0	1.8	2.3	.59
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	--	--	--	--	--	--	--	--	--
Boolean Algebra	--	--	--	--	--	--	--	--	--
Total Test	101	--	--	--	40.2	18.9	42.8	21.2	.48

[a]P Prerequisite--Must possess skill on entrance to course.
R Reviewed--Some level of skill is assumed, but skill is reviewed in course.
T Taught--No previous knowledge assumed, taught explicitly as skill for the course.

*$p \leq .05$.
**$p \leq .01$.

Table 13 (Continued)

Topic	No. of Items	Skill I.D. Numbers by Acquisition Level[a] P	R	T	Entering (E) M	SD	Graduating (G) M	SD	t
			DS School (E = 70, G = 77)						
Arithmetic Ops	7	--	1, 3	--	4.7	1.5	4.9	1.4	.96
Estimation	3	--	5	--	1.2	.9	1.3	.8	.84
Fractions	--	--	--	--	--	--	--	--	--
Units & Conv.	14	11, 12, 13, 15	--	--	6.3	2.7	4.4	2.8	4.03**
Scientific Not.	11	--	18, 19, 20	--	5.3	3.3	3.8	3.8	2.42*
Decibels	--	--	--	--	--	--	--	--	--
Logarithms	--	--	--	--	--	--	--	--	--
Equations	--	--	--	--	--	--	--	--	--
Geometry/Trig.	--	--	--	--	--	--	--	--	--
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	16	--	--	59, 60, 61, 62	5.2	4.6	11.5	3.4	9.62**
Boolean Algebra	32	--	--	63, 64, 65, 66 67, 68, 69, 70	3.2	4.6	13.7	6.5	11.27**
Total Test	83	--	--	--	25.9	12.1	39.8	13.0	6.69**
			EM School (E = 159, G = 222)						
Arithmetic Ops.	15	1	2, 4	--	8.6	3.6	8.7	3.7	.25
Estimation	--	--	6, 7	--	--	--	--	--	--
Fractions	14	9, 10	--	--	7.9	4.1	7.8	4.1	.27
Units & Conv.	24	11, 16	12, 13, 14	--	8.6	6.0	8.1	6.2	.70
Scientific Not.	8	--	18, 19	--	3.5	3.0	3.0	2.9	1.59
Decibels	--	--	--	--	--	--	--	--	--
Logarithms	--	--	--	--	--	--	--	--	--
Equations	15	--	27, 28, 29	--	6.8	4.7	6.6	5.0	.40
Geometry/Trig.	10	46	45	--	2.3	2.8	2.3	2.8	.11
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	--	--	--	--	--	--	--	--	--
Boolean Algebra	6	--	--	64	.0	.0	.2	.8	2.62**
Total Test	92	--	--	--	37.7	20.3	36.7	21.3	.47
			ET School (E = 156, G = 196)						
Arithmetic Ops.	10	--	1, 2, 4	--	6.8	2.6	7.6	2.1	3.10**
Estimation	3	--	5	--	1.4	.8	1.4	.9	.16
Fractions	3	--	6	--	2.4	.8	2.4	.8	.88
Units & Conv.	21	--	11, 12, 13	15, 16, 17	9.9	3.7	11.3	3.6	3.42**
Scientific Not.	12	--	--	18, 19, 20, 21	4.6	3.4	5.7	3.5	2.97**
Decibels	3	--	--	22	.2	.1	.9	.8	12.89**
Logarithms	--	--	--	--	--	--	--	--	--
Equations	9	--	27, 28, 29	--	5.8	2.5	6.6	2.4	3.04**
Geometry/Trig.	3	--	46	--	1.8	1.0	1.9	.9	.94
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	9	--	--	59, 60, 61	1.2	2.5	7.0	2.8	20.14**
Boolean Algebra	18	--	--	63, 64, 65, 67, 69, 70	2.3	3.0	9.5	5.0	15.72**
Total Test	91	--	--	--	36.4	14.0	54.3	15.4	11.29**
			EW School (E = 56, G = 56)						
Arithmetic Ops.	10	--	1, 4	--	6.7	2.2	6.9	2.1	.66
Estimation	--	--	--	--	--	--	--	--	--
Fractions	12	--	6, 7, 9, 10	--	7.0	3.5	8.1	3.5	1.60
Units & Conv.	30	--	11, 12, 13, 14, 16, 17	--	12.6	5.7	13.5	4.8	.91
Scientific Not.	15	--	18, 19, 20, 21	--	4.4	3.6	6.3	3.7	2.68**
Decibels	4	--	--	22	.2	.4	1.8	1.0	10.66**
Logarithms	10	--	--	23, 25	1.1	1.8	2.7	2.1	4.21**
Equations	14	--	27, 28, 29	--	6.6	4.4	8.0	3.5	1.90
Geometry/Trig.	--	--	--	--	--	--	--	--	--
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	--	--	--	--	--	--	--	--	--
Boolean Algebra	--	--	--	--	--	--	--	--	--
Total Test	95	--	--	--	38.6	16.3	47.2	15.3	2.87**

[a]P Prerequisite--Must possess skill on entrance to course.
R Reviewed--Some level of skill is assumed, but skill is reviewed in course.
T Taught--No previous knowledge assumed, taught explicitly as skill for the course.

*$p \leq .05$.
**$p \leq .01$.

Table 13 (Continued)

Topic	No. of Items	Skill I.D. Numbers by Acquisition Level[a] P	R	T	Entering (E) M	SD	Graduating (G) M	SD	t
			FT School (E = 165, G = 154)						
Arithmetic Ops.	16	--	1, 2, 4	--	9.9	3.6	9.2	3.8	1.77
Estimation	--	--	--	--	--	--	--	--	--
Fractions	--	--	--	--	--	--	--	--	--
Units & Conv.	25	11, 12, 13	16, 17	--	12.0	4.6	11.1	4.8	1.64
Scientific Not.	13	20	18, 19	--	4.7	4.2	4.6	4.1	.33
Decibels	--	--	--	--	--	--	--	--	--
Logarithms	--	--	--	--	--	--	--	--	--
Equations	--	--	--	--	--	--	--	--	--
Geometry/Trig.	10	--	46, 47	--	3.2	2.3	3.4	2.2	.95
Phasors	15	--	54, 55	52	.5	1.5	.4	1.0	.80
Number Bases	--	--	--	--	--	--	--	--	--
Boolean Algebra	--	--	--	--	--	--	--	--	--
Total Test	88	--	--	--	34.5	14.5	32.5	14.6	1.20
			GM School (E = 96, G = 152)						
Arithmetic Ops.	15	1	2, 4	--	8.1	3.4	8.7	3.1	1.52
Estimation	--	--	--	--	--	--	--	--	--
Fractions	9	--	6, 7, 9	--	4.4	2.6	4.1	2.6	.86
Units & Conv.	18	12	11, 13, 14	17	5.7	2.8	4.3	3.1	3.67**
Scientific Not.	--	--	--	--	--	--	--	--	--
Decibels	--	--	--	--	--	--	--	--	--
Logarithms	--	--	--	--	--	--	--	--	--
Equations	20	27	--	28, 29	5.6	4.4	4.8	4.3	1.34
Geometry/Trig.	--	--	--	--	--	--	--	--	--
Phasors	--	--	--	--	--	--	--	--	--
Number Bases	--	--	--	--	--	--	--	--	--
Boolean Algebra	24	--	--	63, 64, 65, 67	1.3	1.8	2.7	2.9	4.12**
Total Test	86	--	--	--	25.1	11.1	24.6	11.8	.33

[a]P Prerequisite--Must possess skill on entrance to course.
R Reviewed--Some level of skill is assumed, but skill is reviewed in course.
T Taught--No previous knowledge assumed, taught explicitly as skill for the course.

*$p \leq .05$.
**$p \leq .01$.

Table 14

ASVAB Scores of Entering and Graduating Students

ASVAB Test	Entering (E) M	Entering (E) SD	Graduating (G) M	Graduating (G) SD	t
AE School (E = 142, G = 157)					
Word Knowledge	56.8	7.3	55.4	6.7	1.80
Arithmetic Reasoning	55.4	7.2	55.2	6.2	.34
Mechanical Comprehension	53.3	7.7	54.2	7.8	1.01
Attention to Detail	52.4	11.6	52.3	10.1	.05
Numerical Operations	53.4	7.0	53.2	7.3	.18
Shop Information	55.0	9.4	55.0	7.6	.04
Electronics Information	56.6	8.0	57.5	7.0	.99
Mathematics Knowledge	56.9	7.1	57.3	6.2	.48
General Science	56.0	8.2	56.5	7.0	.47
General Information	54.9	10.2	54.7	8.4	.18
Space Perception	54.9	9.4	55.1	8.4	.25
Automotive Information	54.0	8.9	54.1	8.4	.10
AV School (E = 148, G = 163)					
Word Knowledge	59.3	5.7	58.7	5.9	.86
Arithmetic Reasoning	58.6	5.2	58.4	5.7	.30
Mechanical Comprehension	57.7	7.0	57.7	5.9	.09
Attention to Detail	50.9	8.7	52.2	9.8	1.19
Numerical Operations	53.4	7.2	54.2	7.3	1.05
Shop Information	57.1	7.5	56.3	7.1	.94
Electronics Information	60.3	6.2	60.0	5.5	.44
Mathematics Knowledge	60.2	4.8	60.2	7.2	.04
General Science	60.5	5.6	60.5	6.5	.10
General Information	57.2	6.8	55.6	7.8	1.90
Space Perception	58.5	6.6	57.4	8.0	1.32
Automative Information	57.0	7.7	55.4	7.5	1.82
CEG School (E = 7, G = 20)					
Word Knowledge	53.7	5.2	54.0	8.2	.10
Arithmetic Reasoning	51.7	7.9	55.2	5.2	1.34
Mechanical Comprehension	54.3	8.0	53.8	7.7	.13
Attention to Detail	54.3	8.6	52.4	5.9	.49
Numerical Operations	52.0	3.7	53.0	8.0	.44
Shop Information	54.3	7.3	53.0	8.0	.39
Electronics Information	53.6	7.3	55.2	6.5	.56
Mathematics Knowledge	56.9	3.3	56.4	4.1	.30
General Science	54.0	5.7	54.8	6.4	.12
General Information	50.0	7.0	54.2	9.0	1.11
Space Perception	55.3	11.3	53.2	6.3	.62
Automotive Information	51.1	6.0	52.0	9.2	.22
CEP School (E = 18, G = 29)					
Word KNowledge	55.4	4.2	54.9	6.8	.28
Arithmetic Reasoning	53.1	4.7	55.1	6.0	1.21
Mechanical Comprehension	52.3	6.0	52.3	8.5	.00
Attention to Detail	53.2	7.8	53.5	8.6	.14
Numerical Operations	52.6	6.2	53.9	6.4	.66
Shop Information	55.5	8.2	55.1	7.3	.17
Electronics Information	55.2	8.0	57.9	8.5	1.06
Mathematics Knowledge	56.2	5.3	57.2	5.0	.66
General Science	57.5	4.6	55.6	6.3	1.09
General Information	50.6	4.9	53.0	8.1	1.13
Space Perception	56.4	7.9	54.3	7.8	.92
Automotive Information	49.9	9.8	52.8	8.6	1.04

Note. ASVAB scores were not available for all students participating in this effort.

Table 14 (Continued)

ASVAB Test	Entering (E) M	SD	Graduating (G) M	SD	t
		DS School (E = 62, G = 63)			
Word Knowledge	60.0	5.5	59.3	5.8	.72
Arithmetic Reasoning	59.4	5.0	61.0	5.7	1.68
Mechanical Comprehension	57.1	7.7	56.9	6.0	.18
Attention to Detail	52.5	9.0	52.4	7.2	.06
Numerical Operations	54.5	6.3	55.7	6.7	1.05
Shop Information	57.7	6.5	56.7	6.7	.83
Electronics Information	61.6	6.1	61.4	5.7	.12
Mathematics Knowledge	59.6	4.2	61.2	4.3	2.15*
General Science	60.6	5.6	60.5	5.6	.06
General Information	57.3	6.5	56.3	6.4	.91
Space Perception	55.2	6.9	56.1	8.5	.64
Automotive Information	57.1	8.0	57.6	7.6	.35
		EM School (E = 127, G = 192)			
Word Knowledge	56.7	7.7	54.8	7.9	2.08*
Arithmetic Reasoning	58.4	6.1	56.6	6.9	2.36*
Mechanical Comprehension	55.4	8.0	54.5	7.3	0.95
Attention to Detail	52.5	8.5	52.6	8.4	.07
Numerical Operations	54.8	7.4	54.4	7.0	.50
Shop Information	55.5	7.7	54.1	8.3	1.48
Electronics Information	57.8	8.0	56.3	7.7	1.67
Mathematics Knowledge	60.5	5.6	59.6	5.1	1.44
General Science	57.9	7.3	56.6	7.7	1.44
General Information	54.9	7.6	53.8	8.2	1.13
Space Perception	56.2	8.4	55.7	7.7	.63
Automotive Information	54.7	7.5	52.1	8.2	2.85**
		ET School (E = 143, G = 186)			
Word Knowledge	70.8	2.4	60.0	5.4	22.83**
Arithmetic Reasoning	61.1	6.2	62.0	5.3	1.43
Mechanical Comprehension	59.6	6.5	58.3	7.2	1.69
Attention to Detail	56.0	7.8	53.3	9.4	2.81**
Numerical Operations	56.1	9.2	55.8	6.8	.34
Shop Information	57.6	6.0	56.1	6.7	2.10*
Electronics Information	55.6	7.2	61.2	5.6	7.91**
Mathematics Knowledge	60.6	5.8	62.9	4.4	4.10**
General Science	61.8	5.4	61.7	6.4	.24
General Information	61.0	6.7	57.0	6.8	5.36**
Space Perception	57.6	7.1	57.8	8.0	.34
Automotive Information	58.2	7.4	56.3	6.7	2.49*
		EW School (E = 55, G = 55)			
Word Knowledge	58.3	6.1	59.5	5.3	1.09
Arithmetic Reasoning	56.0	6.0	59.3	5.0	3.21**
Mechanical Comprehension	53.5	8.4	57.6	7.0	2.77**
Attention to Detail	56.1	7.2	52.5	8.5	2.45*
Numerical Operations	57.4	6.5	54.4	6.4	2.44*
Shop Information	57.4	6.4	55.8	6.7	1.31
Electronics Information	60.0	5.7	61.0	5.6	.95
Mathematics Knowledge	60.4	4.8	60.0	4.9	.67
General Science	60.0	6.0	60.7	5.3	.59
General Information	60.0	6.2	59.0	6.6	.80
Space Perception	57.0	8.1	56.9	6.2	.04
Automotive Information	56.3	7.7	55.5	5.9	.60

Note. ASVAB scores were not available for all students participating in this effort.

*$p \leq .05$.
**$p \leq .01$.

Table 14 (Continued)

ASVAB Test	Entering (E) M	Entering (E) SD	Graduating (G) M	Graduating (G) SD	t
FT School (E = 148, G = 145)					
Word Knowledge	64.0	22.2	61.6	22.5	.83
Arithmetic Reasoning	65.2	21.5	64.9	20.5	.10
Mechanical Comprehension	59.5	24.3	62.4	23.4	.81
Attention to Detail	59.9	22.5	59.4	22.7	.18
Numerical Operations	57.6	24.2	58.7	24.6	.37
Shop Information	60.9	23.3	60.5	22.5	.13
Electronics Information	56.9	22.0	58.9	22.7	.69
Mathematics Knowledge	64.7	22.6	62.2	22.1	.85
General Science	54.1	24.6	57.0	23.1	.95
General Information	62.0	22.2	63.7	23.1	.55
Space Perception	54.0	20.4	57.0	17.9	1.13
Automotive Information	52.0	22.8	53.0	23.7	.32
GM School (E = 81, G = 139)					
Word Knowledge	56.1	5.6	55.1	7.0	1.06
Arithmetic Reasoning	54.9	6.1	54.3	5.9	.72
Mechanical Comprehension	54.8	6.7	54.0	7.3	.82
Attention to Detail	50.5	8.6	50.8	8.4	.26
Numerical Operations	51.0	5.8	50.7	6.6	.38
Shop Information	55.8	7.4	54.7	6.7	1.10
Electronics Information	57.1	6.3	57.4	5.1	.44
Mathematics Knowledge	55.6	6.6	55.5	5.7	.05
General Science	57.5	7.3	56.7	7.2	.81
General Information	56.1	7.3	54.6	6.8	1.46
Space Perception	55.9	6.9	54.4	8.7	1.32
Automotive Information	55.6	7.1	53.8	7.6	1.70

Note. ASVAB scores were not available for all students participating in this effort.

Table 15
Intercorrelations of AE School Performance Data
With Math Tests and ASVAB Tests

Math Tests	Pract. 1	Pract. 2	Pract. 3	Pract. 4	Pract. 5	Pract. 6	Pract. 7	Written 1	Written 2	Math	Non Math 2
Total Test	.06	.16*	.06	.25**	.06	.16*	.17*	.41**	.38**	.19	.37*
Arithmetic Ops.	.11	.14	.11	.27**	.04	.06	.11	.34	.23	.13	.23
Estimation	.09	-.05	.00	.17	.04	.01	.10	-.01	-.02	-.12	-.02
Fractions	.00	.02	.03	.24	-.02	.17	.13	.20	.28	.20	.28
Units & Conv.	.09	.09	.00	.19	.08	.20*	.20*	.48**	.32	.15	.31*
Sci. Notation											
Decibels											
Logarithms											
Equations	.01	.23**	.06	.10	.06	.07	.08	.23	.39**	.19	.39**
Geom./Trig.	-.01	.14	.03	.14	.02	.08	.12	.19	.18	-.01	.18
Phasors											
Number Bases											
Boolean Alg.											
"A" School											
Practical 1		.13	.16	.09	-.03	-.06	.03	.01	.17	-.13	.17
Practical 2			.20	.03	.07	.10	.16	.11	.12	.21	.11
Practical 3				-.09	-.12	-.01	.02	.15	.04	-.14	.04
Practical 4					.18	.13	.05	.11	.03	.24	.03
Practical 5						.19	.00	.17	.02	.22	.01
Practical 6							.24	.11	.43**	.18	.42**
Practical 7								.08	.08	.26	.08
Written 1											
Written 2										.14	.99**
Math											.11

Notes.
1. Pract. 1--Working with a troubleshooting training device, the AE reads measurements to determine state of system, troubleshoots from symptom information, and performs repairs at the component level.
2. Pract. 2--AE troubleshoots basic circuits using a VTVM and learns to use an oscilloscope for basic electronic measurements.
3. Pract. 3--AE performs simple maint. and troubleshooting functions on a representative aircraft electrical power supply and distribution system.
4. Pract. 4--AE performs simple checks and maint. procedures and performs troubleshooting on representative aircraft engine instrument training device.
5. Pract. 5--AE performs simple checks and maint. procedures and performs troubleshooting on a training device for a representative aircraft equipment instrument system.
6. Pract. 6--AE performs checks, maintains, troubleshoots, and specifies necessary repair procedures for a rep. aircraft's exterior lighting system, fire warning system, angle of attack system, and manual flight control trim system.
7. Pract. 7-- AE performs scheduled maint. checks on a rep. aircraft using "Look" and "Fix" maint. procedures.
8. Written 1 and Written 2--First and second 50 items of final exam (Exams 3161 and 3162) (Some students did not receive scores for both parts due to faulty scoring procedures)
9. Math.--Math-related items from Exam 3162. No math-related items in Exam 3161.
10. Nonmath 1 and Nonmath 2--Non-math-related items from Exams 3161 (all) and 3162.
*$p \leq .05$.
**$p \leq .01$.

Table 15 (Continued)

ASVAB Tests	Pract. 1	Pract. 2	Pract. 3	Pract. 4	Pract. 5	Pract. 6	Pract. 7	Written 1	Written 2	Math	Nonmath 2
Word Knowledge	.02	-.02	.02	-.11	.05	-.02	-.03	.24	.23	.02	.23
Arith. Reason.	.02	.08	.07	.00	-.22	.04	.06	.01	-.03	-.00	-.03
Mech. Comp.	.16*	.06	.04	.06	.03	.01	.09	.24	.09	.11	.09
Att'n. to Detail	.13	.01	.17*	.03	-.14	-.00	-.07	.10	.22	.02	.22
Numerical Ops.	.05	.07	.10	.08	-.16	.11	-.01	-.07	.32*	.16	.32*
Shop Info.	.11	.04	.02	-.03	-.05	-.02	.06	.16	.09	-.04	.09
Elect. Info.	.09	-.07	.05	.02	-.01	-.03	.03	.14	.16	-.12	.17
Math Knowledge	.04	.22**	.17	.14	-.04	.08	.08	.10	.29*	.17	.29*
Gen'l. Science	-.09	.05	-.01	-.11	-.01	-.02	.02	.17	.36*	.02	.36*
Gen'l. Info.	-.13	-.01	.01	-.02	-.04	.04	-.06	.12	.06	.02	.06
Space Percep.	.07	.08	.16	.00	.01	.09	-.08	.15	.30*	-.09	.31*
Auto. Info.	.15	.07	.13	-.03	-.13	.02	.02	.15	.09	-.07	.09

Notes.

1. Pract. 1--Working with a troubleshooting training device, the AE reads measurements to determine state of system, troubleshoots from symptom information, and performs repairs at the component level.
2. Pract. 2--AE troubleshoots basic circuits using a VTVM and learns to use an oscilloscope for basic electronic measurements.
3. Pract. 3--AE performs simple maint. and troubleshooting functions on a representative aircraft electrical power supply and distribution system.
4. Pract. 4--AE performs simple checks and maint. procedures and performs troubleshooting on representative aircraft engine instrument training device.
5. Pract. 5--AE performs simple checks and maint. procedures and performs troubleshooting on a training device for a representative aircraft equipment instrument system.
6. Pract. 6--AE performs checks, maintains, troubleshoots, and specifies necessary repair procedures for a rep. aircraft's exterior lighting system, fire warning system, angle of attack system, and manual flight control trim system.
7. Pract. 7-- AE performs scheduled maint. checks on a rep. aircraft using "Look" and "Fix" maint. procedures.
8. Written 1 and Written 2--First and second 50 items of final exam (Exams 3161 and 3162) (Some students did not receive scores for both parts due to faulty scoring procedures)
9. Math.--Math-related items from Exam 3162. No math-related items in Exam 3161.
10. Nonmath 1 and Nonmath 2--Non-math-related items from Exams 3161 (all) and 3162.

*p. $\leq$ .05.
**p. $\leq$ .01.

Table 16

Intercorrelations of AV School Performance Data
with Math Tests and ASVAB Tests

Math Tests	MOD 555	MOD 900	Practical	ASVAB Tests	MOD 555	MOD 900	Practical
Total Test	.21*	.26**	.13	Word Knowledge	.21*	.18*	.03
Arithmetic Ops.	.11	.11	.15	Arith Reasoning	-.04	.02	-.01
Estimation	.19*	.14	.00	Mech. Comp.	.22*	.35**	.28**
Fractions	.11	.25**	.01	Att'n. to Detail	-.14	.04	.03
Units & Conv.	.24*	.24*	.11	Numerical Ops.	.01	.15	.11
Sci. Notation	.02	.11	.08	Shop Information	.21*	.22*	.18*
Decibels				Elect. Information	.29**	.28**	.30**
Logarithms				Math. Knowledge	.04	.20	.24*
Equations	.04	.15	.05	General Science	.23*	.19*	.11
Geometry/Trig.				General Info.	.15	.14	.21*
Phasors				Space Perception	.15	.13	.18*
Number Bases	.08	.11	.01	Automotive Info.	.30**	.18*	.14
Boolean Algebra	.28**	.29**	.18*				
"A" School							
MOD 555		.53**	.20*				
MOD 900			.30**				
Practical							

Notes.

1. MOD 555 is the midcourse written examination and MOD 900, a comp. final exam.
2. Practical score consists of the total number of errors accross all AV school practical exams.

*p. ≤ .05.

**p. ≤ .01.

Table 17

Intercorrelations of CEG School Performance Data
with Math Tests and ASVAB Data

Math Tests	Power	Wire	Sub. Math	Practical	Non-Math
Total Test	.54*	.24	.49*	.39	.40
Arithmetic Ops.	.51*	.18	.41	.31	.35
Estimation	.49*	.51*	.51*	.30	.50*
Fractions	.46*	.05	.46*	.08	.25
Units & Conv.	.27	.37	.27	.60**	.33
Sci. Notation					
Decibels					
Logarithms					
Equations	.25	-.15	.24	.02	.04
Geom./Trig.	.58*	.66**	.36	.65**	.68**
Phasors					
Number Bases					
Boolean Alg.					

ASVAB Tests	Power	Wire	Sub. Math	Practical	Non-Math
Word Knowledge	.29	.38	.17	.22	.37
Arith. Reason.	.36	.38	.42	.22	.36
Mech. Comp.	.60**	.76**	.56*	.51*	.71**
Att'n. to Detail	-.18	-.18	-.1[illegible]	-.53	-.18
Numerical Ops.	.03	-.25	[illegible]	-.05	-.15
Shop Info.	.37	.60**	.37	.40	.50*
Elect. Info.	.37	.65**	.27	.33	.55*
Math Knowledge	.15	.01	.15	.29	.08
Gen'l. Science	.33	.46*	.34	.59**	.40
Gen'l. Info.	.41	.50*	.56	.62**	.44
Space Percep.	-.00	.03	.14	-.03	.04
Auto. Info.	.19	.38	.18	.37	.30

"A" School	Power	Wire	Sub. Math	Practical	Non-Math
Power		.74**	.82**	.43	.92**
Wire			.55*	.59**	.94**
Sub. Math				.28	.65**
Practical					.56*
Non-Math					

Notes.
1. Power is a final written exam. dealing with power generation and distribution.
2. Wire is a final written exam dealing with interior wiring.
3. Submath is the score on math items from power and wire exams.
4. Practical requires a two-man team to put up power poles and install wiring thereon.
5. Nonmath is the score on nonmath-related items from the power and wire exams.

*p. $\leq .05$.
**p. $\leq .01$.

Table 18

Intercorrelations of CEP School Performance Data
with Math Tests and ASVAB Tests

Math Tests	Power	Wire	Comm.	Pole	Cubicle	Final	Non-Math	Math
Total Test	.45*	.50**	.27	.07	.00	.57**	.38	.16
Arithmetic Ops.	.44*	.43*	.24	.09	-.06	.64**	.38	.23
Estimation	.39*	.48*	.45	.44	.09	.35	.35	.18
Fractions	.12	.33	.15	-.08	-.06	.37*	-.08	.36
Units & Conv.	.39*	.45*	.22	.02	.00	.44*	.29	.28
Sci. Notation								
Decibels								
Logarithms								
Equations	.43*	.43*	.30	.13	.08	.49	.44	-.38
Geom./Trig.	.35	.25	.09	-.01	-.02	.35	.28	-.13
Phasors								
Number Bases								
Boolean Alg.								
"A" School								
Power (Pract.)		.50**	.45*	.56**	.26	.67**	.99**	-.31
Wire (Pract.)			.68**	.29	.64**	.14	.76**	-.16
Communications (Pract.)				.65**	.54**	.17	.77**	-.16
Pole Climbing (Pract.)					.17	.38*	.83**	-.32
Cubicle (Pract.)						-.17	.81**	-.28
Final (Written)							.99**	-.27
Non-Math								-.37
Math								
ASVAB Tests								
Word Knowledge	.27	-.08	.04	.16	-.25	.46*	.22	.45
Arith. Reason.	.36	.27	.17	.20	-.08	.49**	.07	.32
Mech. Comp.	.44*	.30	.27	.30	.11	.4[illegible]*	.31	-.07
Att'n. to Detail	.15	.25	.20	.11	.21	-.38	.13	-.01
Numerical Ops.	.15	.32	.33	.12	.26	.06	.57*	-.26
Shop Info.	.31	.29	.35	.25	.31	.23	.35	.27
Elect. Info.	.09	.10	.25	.27	.21	.07	.12	.14
Math Knowledge	.40*	.35	.38*	.19	.13	.35	.23	.14
Gen'l. Science	.20	.06	.13	.26	-.18	.34	.25	.43
Gen'l. Info.	.39*	.10	.10	.30	.06	[illegible]	.39	.43
Space Percep.	.05	.07	.17	.10	.07	-.01	.06	-.40
Auto. Info.	.26	.03	-.06	.06	.26	.13	.06	.32

Notes.
1. Power, Wire, Comm., Pole, and Cubicle are practical examinations dealing with power generation and distribution, interior wiring, tactical field telephone and switchboard, pole climbing, and cubicles, respectively.
2. Final is a comprehensive final exam, containing items on power, wire, and comm.
3. Math is the score on math-related items on the final exam.
4. Nonmath is the score on non-math-related items on the final exam.

*$p < .05$.
**$p < .01$.

Table 19

Intercorrelations of DS School Performance Data
With Math Tests and ASVAB Tests

Math Tests	Boolean	No. Sys.	Logic	Comps.	Lab Tot.	Writ. Tot.	Final Tot.
Total Test	.36*	.49**	.44**	.25	.29*	.40**	.53**
Arithmetic Ops.	.21	.28	.31	.12	.13	.13	.26
Estimation	.31*	.32*	.20	.09	.22	.24	.33*
Fractions							
Units & Conv.	.22	.25	.31*	.26	.03	.19	.28
Sci. Notation	.29*	.37*	.24	.14	.23	.24	.32*
Decibels							
Logarithms							
Equations							
Geom./Trig.							
Phasors							
Number Bases	.29*	.34*	.28	.16	.21	.39**	.40**
Boolean Alg.	.20	.38**	.33**	.18	.25	.32*	.44**
"A" School							
Boolean		.49**	.38**	.20	.28	.44**	.53**
Number Systems			.24	.30*	.13	.47**	.57**
Logic				.12	.02	.27	.47**
Complements					-.02	.16	.20
Lab Total						.27	.32*
Written Total							.89**
Final Total							

Notes:
1. Boolean Algebra, Number Systems, Logic, and Complements are weekly sectional examinations.
2. Lab Total is the average of all lab. exams. administered during the course.
3. Written Total is the average of all sect. exams. administered during course.
4. Final Total is a weighted average of lab. total and written total.

*$p \leq .05$.

**$p \leq .01$.

Table 19 (Continued)

ASVAB Tests	Boolean	No. Sys.	Logic	Comps.	Lab. Tot.	Writ. Tot.	Final Total
Word Knowledge	-.03	.04	-.08	.10	-.01	.03	.00
Arith. Reason.	.24	.33*	.32*	.14	.03	.20	.28
Mech. Comp.	.01	-.06	.09	.08	.10	.09	.12
Att'n. to Detail	.15	.05	.00	.27	.12	.24	.24
Numerical Ops.	.10	.09	-.06	-.19	-.03	.12	.13
Shop Info.	.07	.12	.03	.00	.01	.12	.14
Elect. Info.	-.01	-.06	-.09	.01	.08	.10	.08
Math. Knowledge	.16	.05	.10	.04	.30*	.13	.19
Gen'l. Science	.20	.09	.14	.15	.28	.07	.11
Gen'l. Info.	-.12	.25	.01	.18	-.23	.08	.06
Space Percep.	.28	.11	.12	.00	.27	.12	.18
Auto. Info.	-.11	.03	-.05	.04	-.06	.06	.01
CLEP G	.43	.39	.44	.22	.27	.17	.33*
CLEP NS	.56	.42	.43	.28	.22	.29*	.40**
CLEP MC	.31	.32	.41	.18	.31*	.08	.25

Notes.
1. Boolean Algebra, Number Systems, Logic, and Complements are weekly sectional examinations.
2. Lab Total is the average of all lab. exams. administered during the course.
3. Written Total is the average of all sect. exams administered during course.
4. Final Total is a weighted average of lab. total and written total.
*p. ≤ .05.
**p. ≤ .01.

Table 20

Intercorrelations of EM School Performance Data
with Math Tests and ASVAB Tests

Math Tests	Prac.	Writ.	Math Raw	Non-Math
Total Test	.10	.43**	.09	.38**
Arithmetic Ops.	.14	.29**	.14	.23**
Estimation				
Fractions	-.01	.16	.06	.14
Units & Conv.	.13	.43**	.07	.39**
Sci. Notation	.02	.38**	.02	.36**
Decibels				
Logarithms				
Equations	.07	.44**	.09	.39**
Geom./Trig.	.10	.44**	.10	.38**
Phasors				
Number Bases				
Boolean Alg.	.11	.17*	.15	.15
"A" School				
Practical		.13	.04	.12
Written			.15	.95
Math				-.16
Non-Math				

ASVAB Tests	Prac.	Writ.	Math Raw	Non-Math
Word Knowledge	.13	.20*	-.09	.21*
Arith. Reason.	.15	.16	-.02	.12
Mech. Comp.	.18*	.28**	.00	.24**
Att'n. to Detail	.13	.12	.01	.12
Numerical Ops.	-.03	.19	.02	.18*
Shop Info.	.19*	.14	-.03	.10
Elect. Info.	.23**	.39**	.01	.36**
Math Knowledge	.12	.32**	.01	.29**
Gen'l. Science	.09	.20*	-.07	.20*
Gen'l. Info.	.09	.13	-.03	.11
Space Percep.	.21*	.11	-.01	.07
Auto. Info.	.17*	.15	-.12	.14

Notes.
1. Practical is the sum of all practical scores obtained throughout the course.
2. Written is the comprehensive written final examination.
3. Math Raw is the number of math items answered correctly on the final exam; and Nonmath, the score on non-math-related items.

*$p \leq .05$.
**$p \leq .01$.

Table 21

Intercorrelations of ET School Performance Data With Math Tests and ASVAB Tests

Math Tests	Sum Writ.	Sum Lab	ASVAB Tests	Sum Writ.	Sum Lab
Total Test	.10	.58**	Word Knowledge	-.05	.26**
Arithmetic Ops.	-.06	.21*	Arith Reasoning	.07	.21*
Estimation	.08	.25**	Mech. Comp.	.14	.35**
Fractions	.00	.15	Att'n. to Detail	.09	.20*
Units & Conv.	-.01	.53**	Numerical Ops.	.06	.01
Sci. Notation	.09	.49**	Shop Information	.13	.20*
Decibels	.25**	.53**	Elect. Information	.02	.31**
Logarithms			Math. Knowledge	.09	.39**
Equations	.06	.42**	General Science	-.08	.26**
Geometry/Trig.	-.02	.22*	General Info.	.13	.35**
Phasors			Space Perception	.25**	.25**
Number Bases	.12	.24**	Automotive Info.	.10	.35**
Boolean Algebra	.13	.45**			
"A" School					
Sum Written		.31**			
Sum Lab					

Notes.

1. Sum Written is the sum of all written sectional exam. scores for the course.
2. Sum Lab is the sum of all laboratory scores for the course.

$^{*}p \leq .05$.

$^{**}p \leq .01$.

Table 22

Intercorrelations of EW School Performance Data
With Math Tests and ASVAB Tests

Math Tests	Prac.	Final 11	Final 12	Final 13	Math 11	Math 12	Math 13	Non-Math 11	Non-Math 12	Non-Math 13
Total Test	.20	.56	.28	.19	.74*	.58	.40	.38	.10	-.05
Arithmetic Ops.	.12	.31	.35	-.01	.55	.38	.46	.28	.29	.38
Estimation										
Fractions	.03	.21	.32	.06	.58	.52	.29	.01	.17	-.15
Units & Conv.	.12	39	.30	.26	.33	.54	.42	.35	.15	.04
Sci. Notation	.18	.46	.26	.48	.60*	.43	.32	.31	.14	.43
Decibels	.12	.27	.15	-.13	.61*	.22	-.22	.07	.09	-.02
Logarithms	.30	.54	-.01	-.03	.47	.32	.22	.47	-.16	-.22
Equations	.19	.59*	-.12	.00	.74*	.26	.23	.40	-.28	-.19
Geom./Trig.										
Phasors										
Number Bases										
Boolean Alg.										
ASVAB Tests										
Word Knowledge	-.06	.22	-.15	.07	-.06	-.15	.03	.30	-.12	.07
Arith. Reason.	.10	.46	-.07	.07	.55	.15	.15	.33	-.16	-.02
Mech. Comp.	.09	.52	-.15	.39	.56	-.14	.24	.40	-.13	.36
Att'n. to Detail	-.06	-.19	.02	-.02	.08	-.02	-.43	-.28	.03	.31
Numerical Ops.	.21	-.08	-.04	-.34	-.34	.24	-.35	.05	-.17	-.21
Shop Info.	-.03	-.16	.00	.25	-.05	-.03	.24	-.17	.01	.16
Elect. Irfo.	-.08	.22	-.17	.42	-.05	-.37	.02	.30	-.04	.58
Math Knowledge	.14	.29	.18	.25	.56	.55	.36	.11	-.02	.08
Gen'l. Science	-.12	.09	-.01	.04	-.10	.07	-.10	.15	-.05	.14
Gen'l. Info.	.16	.22	-.03	-.24	.21	.04	.00	.19	-.06	-.35
Space Percep.	.05	-.17	-.44	.43	.08	-.25	.43	-.25	-.46	.27
Auto. Info.	-.13	.34	.27	.41	.40	.06	.08	.25	.31	.52
"A" School										
Practical		.37	.05	.02	.59	.14	.09	.83	-.00	-.04
Final 11					.69			.95		
Final 12						.78			.96	
Final 13							.73			.84
Math 11								.41		
Math 12									.56	
Math 13										.25

Notes:
1. Finals 11, 12, and 13 are variations of the same written final exam.
2. Math 11, 12, and 13 are scores on math-related items for Finals 11, 12, and 13.
3. Practical is an indiv. performance score on a 10-point scale of competency.
4. Nonmath 11, 12, and 13 are scores on nonmath-related items from Finals 11, 12, and 13.

*$p \leq .05$.
**$p \leq .01$.

Table 23

Intercorrelations of FT School Performance Data
with Math Tests and ASVAB Tests

Math Tests	Prac. 1	Prac. 2	Writ. 1	Writ. 2	Avg. Total	Math	Non-Math
Total Test	.20*	.21*	.39**	.37**	.53**	.25*	.45
Arithmetic Ops.	.17	.26**	.17	.15	.33**	.13	.19
Estimation							
Fractions							
Units & Conv.	.11	.18	.32**	.42**	.43**	.22*	.41**
Sci. Notation	.19	.11	.40**	.25*	.48**	.13	.40**
Decibels							
Logarithms							
Equations	.09	.18	.24*	.30**	.37**	.22*	.32**
Geometry/Trig.	.22*	.11	.40**	.33**	.45**	.21*	.43**
Phasors	.13	.07	.21*	.04	.28**	.29**	.19
Number Bases							
Boolean Alg.							
"A" School							
Practical 1		.20	.36	.23	.34	.06	.27
Practical 2			.14	-.03	.33	.21	.13
Written 1				.26	.70	.16	.69
Written 2					.22	.29	.86
Avg. Total						.25	.71
Math							.26
Non-Math							
ASVAB Tests							
Word Knowledge	-.09	.13	.14	.11	.24*	.14	.29**
Arith. Reason.	.09	.05	.10	.12	.15	.09	.18
Mech. Comp.	.07	.25*	.10	.04	.24	-.06	.22*
Att'n. to Detail	.01	.09	.05	-.04	-.03	.11	-.03
Numerical Ops.	-.00	.03	.15	-.01	.08	.25*	.12
Shop Info.	.06	.09	.12	.04	.14	.15	.30**
Elect. Info.	.11	.40**	.24*	.16	.30**	.09	.36**
Math. Knowledge	.13	.05	.26*	.22*	.36**	.09	.36**
Gen'l. Science	.03	.05	.15	.06	.19	-.01	.22*
Gen'l. Info.	.06	.04	.19	.04	.23*	.05	.14
Space Percep.	.11	.32**	.28*	-.07	.24*	-.18	.23*
Auto. Info.	.12	-.00	.16	.05	.14	.02	.34**

Notes:

1. Practical 1 deals with oscilloscope and transistor theory; and Practical 2, with gyro mechanism and synchro mechanism theory.
2. Written 1 is a comprehensive midterm exam; and Written 2, a comp. final exam.
3. Average Total is the overall percentage score at the end of the course, based on two practical scores and 12 weekly written scores.
4. Math is the score on math-related items from the final exam; and Nonmath, the score on nonmath-related items.

$^{*}p \leq .05$.

$^{**}p \leq .01$.

Table 24

Intercorrelations of GM School Performance Data with Math Tests and ASVAB Tests

Math Tests	Practical	Written	ASVAB Tests	Practical	Written
Total Test	.20*	.31**	Word Knowledge	.08	.21*
Arithmetic Ops.	.25**	.29**	Arith Reasoning	.10	.17*
Estimation			Mech. Comp.	.19*	.21*
Fractions	.06	.07	Att'n. to Detail	-.06	-.12
Units & Conv.	.10	.27**	Numerical Ops.	-.09	-.15
Sci. Notation			Shop Information	.03	.18
Decibels			Elect. Information	.14	.21*
Logarithms			Math. Knowledge	.16	.18*
Equations	.12	.21*	General Science	.05	.19
Geometry/Trig.			General Info.	.13	.35**
Phasors			Space Perception	.16	.22**
Number Bases			Automotive Info.	-.04	.17*
Boolean Algebra	.21*	.28**			
"A" School					
Practical		.54			
Written					

Note: Practical is the average of all practical examinations during the course; and Written, the average of the weekly written examination.

* $p \leq .05$.

** $p \leq .01$.

CONCLUSIONS

1. Perhaps the most compelling conclusion of this study is the obvious one: "A" school courses that are primarily limited to basic electronics concepts require only a minimum level of arithmetic operations proficiency in preparation for the course work, and those courses involving more sophisticated electronics concepts (e.g., DS, ET, and EW) require training in advanced mathematics prior to or concurrent with course instruction for superior performance in the course.

2. Performance in mathematics in the electronics ratings is poor even in those topic areas instructors consider crucial to successful performance in an electronics rating. Therefore, either the course-performance tests do not measure appropriate skills, or the instructors have an inaccurate perception of mathematics requirements.

RECOMMENDATIONS

1. The mathematics requirements in the entire electronics training pipeline should be assessed to ensure that skills and knowledges essential for successful fleet performance and subordinate skills and knowledges that enable the trainee to master essential skills are taught. This effort is currently being conducted by NAVPERSRANDCEN.

2. Instruction should be developed to remedy student mathematics deficiencies in areas identified as a result of the implementation of recommendation #1.

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